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ORIGINAL ARTICLES.

"Of all the arts in which the wise excel,
Nature's chief masterpiece is writing well."

A CONSIDERATION OF THE RELATIVE MERITS OF WATTS' CRYSTAL GOLD AMONG FILLING MATERIALS.

BY J. F. P. HODSON, D. D. S. NEW YORK.

Read before the New England Dental Society at its Twenty-Second Annual meeting, held in Boston, Oct. 2 and 3, 1884.

MR. PRESIDENT AND GENTLEMEN—It is with much diffidence, and yet with a lively sense of the honor you have conferred upon me in extending to me the special and very kindly invitation to appear before you, that I am here to-day, and, while thanking you for the distinguished courtesy of which I am the object, cannot but feel how very greatly you might have bettered the selection of your object than your subject. For, very truly, there are few, if indeed there be any, which ought more properly to engage our most serious consideration, than the comparative merits of filling materials for the teeth, as few I think will question, that whatever our surgical or other dental skill or ability, the perfect stopping is, in a very real sense, the *ultima thule* of all dentistry.

As, however, it has been very delicately hinted to me by your committee that your especial hunger is for practical facts, rather than theoretical disquisition, I will plunge at once into the thick of them by the introductory premise that "Watt's Crystal Gold" is not to be confounded with any of the other so-called crystal golds which we have offered us from time to time. It is, as superbly shown under the microscope, an interlaced mass of perfect golden fern leaves, which have been grown up from, and in, the continually saturated solution of gold, by a process of electrical action. While all others that I have ever examined show no organization whatever, but are a mere agglomerated mass of gold particles, which cohere temporarily like wet sand, and are, moreover, produced by chemical action, mercury, etc., methods which were experimented with and abandoned by Watts at least 25 years ago.

I have used this beautiful form of gold exclusively for something more than fifteen years, and associated with other golds, before that time, and so say what I do know, that all operations which can be accomplished with any other gold, or by any other operator, can be at least as perfectly accomplished with this, and with less expenditure of force and strain, and indeed in every sense, with far greater ease of manipulation than with foil golds. Crystal gold possesses moreover some excellencies which do not obtain in foils, one of which is the steel-like hardness of surface of the fillings produced with it, which in grinding surfaces is so especially valuable for their resistance to, and withstanding of, the battering force of mastication, and of the cusps of opposing teeth, and in the exquisite perfection with which it adapts itself under honest manipulation to the walls of the cavity, indeed so close and perfect is it, that delicate pointings of the microscopic crystals have been shown to have entered open ends of the dentinal tubuli themselves. This waxy adaptiveness would be, under any circumstance, a most valuable attribute, but it becomes doubly so when taken in connection with the fact of the gold being condensed with so little force as compared with foil. In such circumstances, for instance, as very frail front teeth, where for appearance sake, it is often expedient to save every atom of even thin remaining enamel, the value of this quality in crystal gold is inestimable, and I wish to be perfectly understood in regard to condensation, in such circumstances of frail walls as just instanced.

The filling should be of course, and is, with faithful manipulation of this gold with small points, practically as closely adapted and as well consolidated against these walls and throughout the stopping, as if against strong walls, and all this where a proper condensation of foil would be far more likely than not, to rupture the enamel, even granting to the foil the most skillful manipulation. If crystal gold can be depended upon to do this so delicate and refined work among "egg shells," what must be its capacity for easy and perfect adaption in the great mass of the usual cavities having strong walls. I deem it a work of supererogation to enlarge upon, or even do more than suggest the point to intelligent professional gentlemen, This wonderful combination of all the compliant and waxy characteristics of "soft" foil with even more of the cohesive quality than is possessed by most cohesive golds, and superadded to this,a very hard finished surface peculiarly its own, are the especial characteristics of Watt's Crystal Gold, and from such a superb *tout ensemble* for gold filling material as that, the application of the motto "multum in parvo" seems especially appropriate.

As I have previously said, I have used this form of gold exclusively for more than fifteen years, and although I always have a quantity of other gold in my gold drawer, and, get most new varieties as they appear, and keep them more or less even on my trays, because I do protest that I despise the prejudiced and obstinate riding of a hobby, and always feel ready to use any gold or any material that I can produce the best results with, in any and each individual case. I am nevertheless wholly unable, as a general rule of every day practice, to find any place in any cavity where I can possibly employ them to any advantage as compared with crystal gold, and am constrained to store away the pellets and cylinders, etc. in the body of large stoppings from time to time, *to get rid of them.* "Aha" I hear some captious critic say "so you *do* manage practically to combine foil with your crystal gold after all." Don't think so gentlemen, I merely and truly, as I say, having kept some foil preparations for a time, I seek to dispose of the—to me—useless material, by putting it where, possibly many of you would say, it would "do the most good," where for myself I would say it could "do the least harm," in the centre of a large stopping, and precisely as I would stow away pieces of crystal gold which had become in any way somewhat condensed,

and, in my opinion, unfit to place next the walls. One exception, however, to my exclusive employment of crystal gold, which I wish to mention, is my habit, as a mere matter of extra prudence, of binding together a largely built out restoration in gold, with occasional strips of heavy foil, feeling that the magnificent hardness of condensed crystal gold might possibly militate against the toughness and consequent integrity of a long, thin restoration. Beside this negative proposition as to my employing no other gold, I wish to place the positive one, that I *do*, with *very* rare exceptions use, only this; that is to say, so far from employing it only for usual operations, and then plastering up all the difficult or large ones with amalgam, I almost never—probably not nearly as often as I ought—employ amalgam, or other plastic filling materials for permanent teeth, and as seldom order teeth out. And I say all this in order to make the point, and to make it plain, that I *never hesitate about doing any operation whatever with crystal gold*, that I depend upon it for all and any dental stoppings or restorations whatsoever, small and great, easy and difficult, and that if any failure occurs (and I am not, I hasten to assure you, one of those transcendent operators who never, never have them) I *know* the failure to be consequent upon my, somehow or somewhere defective manipulation, and not any fault of the gold employed. For instance, if I were to "take a piece as large as the cavity"(as, for many years the instructions accompanying it directed, and which some operators who use it, apparently do now), and jam and plaster it into the cavity trusting to some magic of affection in the gold to seek out the walls of the cavity and cling to them, I should fully expect, as a consequence, the leaky and worthless stopping that is so often seen, and which advertises to all who see it, not the incompetency of the gold, but of the operator who essayed to place it.

Notwithstanding the beautiful, even silky, softness and pliancy of crystal gold as it takes its place in the cavity, it becomes hard under manipulation, and that very quickly, and being cohesive to the last degree, must be treated after this first placing in the cavity like cohesive foil, and, as I have said in a previous paper, if crystal gold be given the same honest care that a conscientious operator would in like circumstances apply to cohesive foil, he would surely produce the same perfect stopping, and in addition receive the benefit of the grand combination of the special beauties and advantages in both soft and cohesive golds.

It is absolutely imperative that the first pieces of crystal gold be held immovably in the position in which they have at first been placed, and retaining points, or an angle of the cavity may be employed for the purpose. My own very decided preference, however, and the method which I employ wherever possible, is to arrange to hold the completed stopping by the general shape of the cavity, rather than by means of the deep pits so often employed, as I greatly deprecate any so unnecessary reaching out toward the pulp with conductive material, as are these retaining points when filled. In this case the first pieces may be held accurately to their position, by means of a pointed instrument in the left hand, continuing its employment till in condensing these first pieces, and proceeding with the stopping, the shape of the cavity is found to hold the gold securely without it. Condensing each piece finally as one progresses, exactly as a careful operator would proceed with cohesive foil, for as I have before remarked crystal gold, *when first applied to the cavity*, is waxy and adaptive as is the softest of soft foils; but there this similarity ends, as it should, and this first application being once made, it must be treated thereafter precisely as though it were cohesive foil.

A good operator when applying a cohesive foil pellet to the cavity would not proceed to disintegrate it by punching it full of holes with a sharp point; neither would he on the other hand attempt to model large thick pieces of it into position with "spoon" modellers and expect anything but a worthless uncondensed cavity-full of something akin to loose shavings or sheet iron scraps as a result. Neither would he jam a large mass of cohesive foil into a cavity, and by thrusting wedge shaped instruments down through it, expect to force it to spread out sidewise and form the perfect adaptation to the walls of the cavity which the merest professional child ought to know is the *sine qua non* to the saving stopping, and yet gentlemen do all of these things, commit all of these sins against crystal gold, and then cry all maledictions upon this gentle material, for the results, forsooth. "You miserable lamb," says the wolf, standing in the stream above him; "how you have roiled up and spoiled this water for me. I will therefore destroy you."

If gentlemen would but—for instance—take the cake of gold carefully and gently between the fingers of the left hand, and, with long pointed tweezers in the right, as carefully push off-without

too close approximation of points of the tweezers—a trayful of small pieces, and then, the rubber dam being in position on the tooth, of course, the cavity dry, etc.—take up one of the pieces on the end of such filling instrument as would be employed were cohesive foil pellets being used (in any shape, so that 'tis small, and is very finely serrated), carry it through the annealing flame, and to the position in the cavity where it is designed to commence the stopping, hold it absolutely still, until it has been fully and entirely condensed, employing any means of condensation which would properly consolidate pellets of cohesive foil, add other pieces, in the same manner, still holding the compacted portion immovably, until it will of a certainty hold itself, adding no single piece however, till that already in the cavity has been fully and finally consolidated, never changing the position of any pellet after its first application to its place, using so small pieces as to be *sure* that no piece is added which, from its size or thickness, they could not, with absolute certainty, condense throughout its substance, without chopping or punching it full of holes, packing directly against the walls of the cavity, and remembering that no cohesive gold spreads or wedges out under manipulation like soft foil, and that consequently all packing must be done directly upon the part desired to be compacted.

In a word, proceeding throughout the operation precisely as though it were cohesive foil pellets which were being employed, and, my word for it, they will be surprised and delighted to find how they would be accomplishing the same results with this gold as with foil, and with how much greater ease and pleasure and delicacy they were doing it.

If then they continued to the end of the placing of the gold and polishing and finely finished the exposed surface, they would find in that such resisting steel-like hardness as is implied in the fact that a patient will return days afterward to have a mere nothing taken off from the surface; *they can't hammer it down*, slight excess tho' it be.

My own preference has always been for No. 1, in contradistinction to the more condensed Nos. 2, 3 and 4, and for such delicate handling of even this, as that it shall certainly *be* No. 1, when it reaches the cavity, and not have been handled and pressed into the equivalent of No. 3 or 4; as the very essence of the value of crystal gold—to my mind—lies in the tremendous difference in bulk

between the exquisitely soft silky state in which it comes to us, and its finally consolidated one in the cavity, and that the great change taking place under the guidance of the instrument of the operator implies all of the possibilities of the marvelously close adaptation to the walls of the cavity of which I have spoken, but which superb attribute of crystal gold is deliberately thrown away, to start with, by using the condensed Nos. 2, 3 and 4,and equally so, by the careless handling and squeezing of No. 1. In short I want to do all of the condensing *in the cavity.*

The ultimate destination of us all, with our varied methods and golds, is the goal of the perfect stopping or restoration, and each being devoted to his own method, and becoming skillful in it, it becomes *his* best one, and we may learn much from these specialists, even tho' we ourselves may either not be specialists, or that we even do not at all employ his particular method.

The soft-foil operator teaches us much about adaptation. The heavy foil man—I'm a little lame here—perhaps the want of it. The cylinder operator about rapidity of operating. The electric foil man lauds its lead-like ductility. This cohesive foil man his general power to restore beyond the cavity, *chacun a son gout.* But it is obviously unfair for one man to test another's method or material by his own manipulations, and then depreciate Pegasus, because forsooth he don't yoke with his ox!

There are many different ways of getting from New York to Liverpool, and, barring accidents, one reaches there certainly, by any one of the many lines, but as between them, ones comfort and pleasure on the way, and his condition upon arrival there are questions upon which each will have his own opinions and predilections; but supposing one to have been long accustomed to the cabins of a "Cunarder" or an "Inman Liner" in his passages across, and upon the representations of a "White Star" patron, decides to try—say—the "Germanie." It is certainly very unhandsome in him, not to say ridiculous, after having heedlessly stumbled down into the hold at the beginning of the voyage, and as heedlessly remained there to the end of it, to go stamping about Liverpool upon his arrival out, exclaiming against the manifest discomforts of the White Star Line and his passage on it, that he was rolled and tumbled about, cut and bruised till he was "all broken up," and indignantly repudiating a suggestion as to his being "tight," or that he had been in that—to him—detestable condition from

the first, declaring that indeed he was so very badly off, that he must now go into hospital to be made over new; and that if there was any one thing sharply defined in his mind, it was that he would never, never use that method of getting to Liverpool again.

"What's that you say; elegant promenade deck and superb sleeping and dining cabins; reading-room and smoking-room and all that?"

"I don't believe it. I never found 'em."

DISCUSSION.

Dr. Fillebrown.—This paper of Dr. Hodson's is so complete in itself there seems to be nothing to say in addition or discussion. I honor a man who has devoted himself to one line of thought or practice and developed it to such a degree of perfection as this; and a so well digested and clear an account of that work, as is the paper just read, I prize very highly. Dr. Hodson's practice illustrates very forcibly the fact, which we all appreciate in some degree, that satisfactory results may be reached by totally different methods. That the doctor obtains good results goes without the saying, for he is one of the very best operators among us.

In my own practice I rely mainly on cohesive gold foil, used in a very attenuated form, one fifth of a sheet of No. 4 rolled into loose ropes and cut into lengths to suit. This is so plastic that it will easily go anywhere a point will follow. I use other forms of gold incidentally—more than that—frequently, in almost every cavity, and crystal gold is always on my case and is often used. Many of our fine operators make non-cohesive foil their main stay, using cohesive gold incidentally to finish with, and thus obtain excellent results. The essayist relies mainly—almost wholly—on crystal gold; using other forms only incidentally and perfect work is the result. Crystal gold I believe and know, to be a perfect form for a filling material, and the operator who takes it for his chief reliance makes a good choice. I thank the doctor for his paper and for his presence, and heartily join in his sentiment that the best way to do a thing is the way you can do it best.

Dr. Clapp.—I am happy to have Dr. Hodson present to-day and give us his experience with crystal gold. A few of us who knew something of his reputation as an operator and his almost exclusive use of this material, wanted him to come and give us the benefit of his experience. And so we have succeeded in inducing

him to be here to-day, although at a considerable sacrifice to himself. It has served to bring to our attention the value of crystal gold. Hereabouts it has been much overlooked. I have used it but little. It has qualites that other gold does not possess. Asked Dr. Hodson how he uses it; whether he uses hand pressure or the mallet, etc.

Dr. Hodson.—As I said in my paper, any method of employing force for the condemnation of cohesive foil pellets or cylinders is appropriate in the same circumstances,to crystal gold. I specify pellets and cylinders because ribbon gold or simply layers of heavy foil can be beautifully consolidated with the electric mallet. Crystal gold cannot because of the superficial nature of the blow and the absence of pushing force in this instrument, and as I have pointed out, crystal gold is prone to condense a crust upon its surface under such action, leaving the underneath part of the pellets uncondensed. If I can get direct action for the mallet, I use it both for rapidity of execution and delicacy. In, however, operations or *parts* of operations where,in the employment of the mallet its action would be to drive the gold away from the walls instead of in direct apposition to them, I certainly should not use it, but should turn to hand pressure,and this happens so constantly during the day's operations, and in different parts of each operation, that I question which I most employ, the mallet or hand pressure. Both sets of instruments are to my hand and are applied to the work according to the demand of the moment.

Dr. Clapp.—I use all the various methods employed in filling, and the varieties of gold also. I fill each cavity by itself; using such methods and material as will enable me to accomplish the desired end in each case in hand. As yet I can use no cohesive gold in undercuts.

Dr. Wetherbee.—I am quite familiar with the history and qualities of crystal gold. I first used it February 7, 1855. The crystal gold of that day was very imperfect when compared with that in use at the present time. A good and substantial filling can be made with crystal gold.

The first point I make is this: that it requires more time, in many cavities double the time,than that of other forms of gold. If time is money, and it is so reputed, then there is a needless waste of the energies of the operator.

The second point is: that there is far greater liability of imper-

fection at the cervical wall than where other forms of gold are used. In the use of pellets of proper size and partially annealed we have a sufficient quantity of gold to be carried against the cervical wall, and extending beyond so as to allow of the most thorough impaction. If retained in position, other pellets may be added until we are ready for the use of cohesive foil. By this method I have a sufficient quantity of gold covering the cervical wall to allow perfect condensation. That portion of the filling being dressed down to a thirty-second part of an inch of the margin of the cavity, is heavily burnished,thereby expanding the gold, bringing it into positive apposition with the *parietes* of the cavity. If there shall be a space of a five hundreth part of an inch between the gold and the wall of the cavity which cannot be determined by the eye unassisted, it will be fatal to the filling. Crystal gold does not expand under the pressure of the burnisher, nor does cohesive foil except to a very limited degree.

The third point I make is: that in deep-seated cavities crystal gold is not so easily or so surely impacted against the labial wall of a central incisor, especially when small space can only be obtained, without serious injury to the form and beauty of the tooth. In such I invariably use non-cohesive foil. It is carried before the instrument to the point indicated and thoroughly impacted, assuring a perfect filling. This was my method when using crystal gold, and is, in like cases, my present method when using cohesive gold.

My fourth point is: that when severe wear or strain by attrition supervenes, it has not the strength or resistance of cohesive foil. It more readily wears away, leaving imperfect margins. For these reasons I long since gave up the use of crystal gold in my general practice.

Dr. Andrews.—I am very much pleased with the paper of Dr.Hodson. I am one of the "few of us" spoken of by Dr.Clapp,who wanted him to come and tell us his experience with crystal gold, because I have used it for many years, and I believe in it. I know I can depend on it. Those who think they can make good fillings of it and make them rapidly are mistaken. It needs the same skill and care that you give cohesive foil, perhaps more in filling around the edges of a cavity. I use it alone and in combination with cohesive and soft foil. If,during the next ten years I could get only one preparation of gold, I should prefer crystal to any other form.

Dr. Waters.—I wish Dr. Hodson would place upon the blackboard the appearance of crystal gold as seen by high powers of the microscope.

Dr. Hodson.—You presume me to be an artist.

Dr. Waters.—Exactly. I have no doubt on that point. Artists work to an idea, and every successful dentist does the same. He sees the end from the beginning and works towards his highest conception of what is true as well as beautiful. It is only by being good artists that we become expert dentists.

Thirty-five years ago I made some crystal gold. One of my patients was a gilder by profession. I asked him what he did with the rags with which he rubbed off the surplus gold leaf. He said they were not good for anything after he got through with them, they were so dirty; and so he threw them away. I asked him to bring me some. He did so. I incinerated them and lixiviated the ashes in aqua-regia,which, after standing some time, I decanted the supernatant fluid and then parted therefrom the gold, silver and copper. The gold was thrown down in a crystalline mass; not the light and feathery article which we now know as crystal gold, but a rather coarser article. That, I did not have skill or patience enough to work successfully. It would crawl towards the instrument with which it was packed just as the first cohesive foil did.

One of the chief hindrances in the way of making a perfect filling is the difficulty in securing a good coaptation at the periphery of the cavity. The doctor here illustrated his method of filling certain cavities by means of mats of gold made of No. 4 foil, folded and cut so as to present the edges of the foil mat at the external surface. [A cut would be necessary to illustrate his method, which we have not the time to give.—Ed.]—"I often find, in fillings that I see, a defect at the cervical wall where the surface of a tooth is depressed at the neck, the gold having been filled straight across, leaving a projecting edge, under which foreign matter accumulates, ferments, and decay is the result. In filling with cylinders of gold there must of necessity be a cuneiform space at the joining which will in the same way give a start to decay."

Dr. Hodson.—In reference to the remarks of my much esteemed friend, Dr. Wetherbee, I have but to say that I fear that much soft foil "hath made him mad," all of his assertions being in direct contradiction of everything in the paper I have read, and to my continual and daily experience of the many years in which I

have used crystal gold exclusively in my practice. At the same time he informs us that the crystal gold of long ago, was a very imperfect material as compared with the beautiful one of to-day, *and* that he *long since* gave up the use of crystal gold.

I may merely say categorecally with him, that

1. Crystal gold takes no more time in the hands of one skilled in its use than does other cohesive golds in hands skilled in *their* use.

2. That perfect cervical edges and the utmost refinement of continuity of tooth substance and gold are as universally made by a skillful operator with this gold, as by skillful operators with any other; and the imperfect and worthless cervical edges are made by an unskillful or careless operator with any other gold as well as this. Cervical margins test the skill of the operator, the soft, cohesive, cylinder, pellet, mat, ribbon, and crystal gold manipulators, each being presumably able to produce perfect ones by his own manipulation of his material.

3. What I have just said applies equally to the "labial walls of the incisor teeth." The skillful operator produces elegant operations with whatever material he employs.

4. Is I think sufficiently answered by my paper which specifically points out as one of the grand and splendid attributes of crystal gold its *specially* hard and resistant wearing surface.

In response now to the request of Dr. Waters, I will try to give you a faint idea of the beauty of crystal gold under the microscope. (Dr. H. here drew upon the black-board a very graceful representation of interlacing fern leaves.)

Dr. Gage.—In my own experience there seems to be more trouble with discoloration of crystal gold fillings than with gold prepared in other forms. I would like to ask Dr. Hodson if he can account for it.

Dr. Hodson.—I scarcely know how to answer that question. It is a condition of things which I do not meet with in my own practice. Except very rarely an isolated case where foil stoppings of other operators were discoloring on their free surface in exactly the same way as my own stoppings beside them, and so I have come to feel such discoloration to be due to the action of some chemical, either formed in the mouth or taken as medicine, as chloride of iron, etc.

Dr. Chandler.—Perhaps I can throw some light on this matter of

discoloration. Some years ago I went into the investigation experimentally of the discoloration of gold in the mouth. I came to the conclusion that the impurity of the gold had little or nothing to do with it, but that it was mainly, if not entirely, caused by the particles of steel worn from our steel pluggers and left upon the gold wherever it has been touched by them. If the fillings are cleaned and made bright again, they will again discolor, showing that the discoloration is not superficial but that the cause extends all through the filling. Some of my experiments showed me that an almost infinitesimal quantity of steel would have this effect. Our steel pluggers are always worn smooth in process of time. Where do the worn-off particles go if they are not left on the gold? An account of these experiments is to be found in *Johnton's Miscellany*, to which I sent it for publication.

Also quite lately Dr. William H. Rollins of this city has gone into the same investigation much more thoroughly. He has had expensive analyses made of the different makes of gold, and has also striven to obtain absolutely pure acids for the purposes of these analyses. This was found a matter of great difficulty, as impurities persistently clung to them. He succeeded at last, however, and arrived at substantially the same result that I did. His paper may be found in the *Medical and Surgical Journal* for September 4, 1884.

Another point which I thought I established was this, viz., that those golds,as crystal gold for example,which required the most careful manipulation, and therefore the most handling with the instruments and the longer time, are the most likely to become discolored, and *vice versa*.

Dr. Hodson.—It may be that I have "builded better than I knew" in my fear of and antagonism to iron in any form that might get associated with my fillings, and may explain why the surfaces of the fillings in the mouths of my patients are as pure and clean as are those of any of my professional brethren. I am excessively careful of the cleanliness of my plugger points; never, under any circumstances use a new one till I have surely cleaned all possible infintesimal bits or filings or scale out from the serrations, and I so greatly fear a point getting magnetic, and so attracting a bit of iron from somewhere, that I keep all magnets and magnetic instruments in a separate room. For, of course, we must keep a magnet for the purpose of magnetizing a pointed instrument to draw out the

little drill point occasionally broken off in a tooth. I was once precipitated into a lot of trouble by an assistant's having heedlessly left a magnet among a drawerful of instruments. I threw them all away.

Dr. Waters.—In manipulating gold from the ingot it is often dipped in acid to dissolve off the flux that adheres to it in pouring from the crucible. Many gold beaters in former times, failing to get a pure gold—copper and iron being the impurities—were in the habit of quenching the ingot, after annealing, in a solution of sulphate of iron or sulphate of copper, and any pores in the surface of the gold would be filled by the quenching and cleaning liquid rushing in to fill up the vacuum. In beating, this would not all be forced out, and when manipulated by steel instruments the acid would come to the surface and act upon the instruments, or the impure metal would itself be dissolved. In either case a red surface of metallic copper, or a dark to a black surface of the oxide of copper or iron would result.

ADDRESS

By Prof. G. V. Black. M. D.,D. ,D, S., at the opening of the Chicago College of Dental Surgery. Oct. 1. Session of 1884-'85.

Ladies and Gentlemen, and Students: You are gathered here this evening for the purpose of beginning a series of studies by which you expect to become fitted for the practice of dentistry. The Faculty of this Institution have chosen that I give the opening lecture of the course, and in this lecture it is my duty to give you, if possible, a better understanding of your future duties in the profession which you propose to enter.

Let me state in the beginning that one's duties to his profession, no matter what that profession may be, includes his whole duty to his fellow man, and to himself. To do this duty requires honesty of purpose, sincerity in the performance of labor, and a correct understanding of the mutual relations of man to man.

These three grand requisites of success we hope each of you have gained in your previous training, so that you come to us with these qualities well fixed and ready to guide you in the special duties that devolve upon you here; for without them, no man can rightfully expect the high measure of success which all must desire.

Dentistry does not differ from the other professions in these respects. There is nothing in this profession which in any wise changes our general duties to our fellow men or relaxes the vigor with which we should labor for the general welfare of the human family; but, on the contrary, the more we learn of the infirmities of men, the stronger should our sympathy with the suffering become, and knit us closer to the rules of right doing. In the prosecution of your studies you will learn more of the mutual needs of men and more of the help that the one may render to the other. Here your study will be man. It is true, much of your time will be spent in the study of the grosser part of man, his material form, structure, and composition; but through this study we expect you to continually approach more and more toward a correct understanding and appreciation of his higher nature; the mental and spiritual. For at the very outset of our studies each of us must perceive that there is something lying beyond the material forms which we are called upon to examine. A force, if you please, that calls these forms into existence, molds their outward conformation,determines their elements, and controls their relationships.

If we examine the human hand we find it composed of bones which have a mutual relation to each other, with cunningly devised joints or hinges by which the end of the one moves upon the end of the other. These relations of the bones are maintained by numerous ligaments, which bear certain relationships to the bones, and to each other. Again, we find that these are threaded throughout by tendons, to which are attached muscles, by the contractions and relations of which the movements of the hand are accomplished. But this is not all of the hand. It is only the grosser mechanics of the hand. Like all other parts of the human frame, it contains in its make up that which is destined to minister to the life of the organ. It is pierced everywhere by minute tubes, arteries, capillaries and veins through which the blood comes and goes for its nutrition, that life may be maintained within its structure. Then we find it everywhere pervaded with nerves through which it becomes obedient to the great central organ, the brain, by which its movements are guided, and without which the whole organ, be it ever so perfect, would be entirely useless to the other organs of the body. All of these we find enveloped in the skin in which the tactile sense is located. All of the parts are woven together into one perfect whole, and all are minutely dependent upon each other.

Without any one of them, or if any become maimed or imperfect, the hand becomes useless, and the whole organism suffers in consequence thereof. For as it is with the hand, so it is with the other organs of the body. Each organ is made up of parts which are mutually dependent upon each other, and each organ is mutually dependent upon the other organs in the general make-up of the body.

Society is similarly framed. Each business or profession has its place of labor, and all are mutually related and dependent upon each other. The welfare of the community depends upon the skill and sincerity with which that labor is performed in each individual case, for it is the individual cases that make up the whole. If the physician neglects his duty, or performs it in a bungling manner,or proves incompetent through lack of diligence in preparation, an individual is injured. Society has suffered in the person of one of its members and has a right to complain. This person has also brought a reproach upon his profession. The same is true of individual actions everywhere, and in the professions especially. For we of the medical profession become by virtue of our special studies, not only the servants of, but the advisors of other members of society in matters of the gravest importance, and society has the right to demand that we be well qualified.

In all the associated parts of the animal body life is maintained. What is life? Webster defines the word thus: "That state of an animal or plant in which its organs are capable of performing their functions." It will be seen at once that this definition is based on certain of the physical attributes of life. It does not tell us what life is, but that life exists when certain phenomena are observed. We say a thing lives when we see it performs certain movements or undergoes certain processes of growth and multiplication. While this may approach as nearly a definition as we are able to frame with our present knowledge, every thinking man, must,when he ponders the subject, admit that this is not life. There exists a power behind all these manifestations that we are unable to explain. What is it that holds the elements of which our bodies are composed together, and gives to the mass its physical form? What is it that determines its cellular structure, and maintains each of these minute portions in its relations to the general mass? We say it is life. The work of nutrition is under the guidance of this peculiar force. Indeed, all the operations by which animal ex-

istence is maintained, is the work of life. Yet we can only recognize life through its manifestations. We cannot come in contact with life itself with our physical senses, although these senses constitute one of the highest endowments of life. Matter does not live. Life is a subtle power which invests matter with peculiar attributes, or rather, brings it into subjection for a time, and causes it to take on new and varied affinities leading to complex combinations for the formation of the wonderful forces which we know as animals and plants. Still in the higher sense matter does not live. This power is evident for the time in the animal or plant, and in our common modes of expression, we say, it lives, yet there is nothing there that we can recognize by our physical senses but matter. The animal dies. That power or force which we call life has departed from it, and all at once the phenomena of life have vanished. At this moment there may be no change in the matter. The organs of the body are each in their respective places. Each individual cell maintains for a time its form and composition. Death does not change the physical form. It is simply the withdrawal of that power or force by which these combined phenomena have been carried on and the form constructed. Matter may properly be said to be vivified. It may be brought under the influence of the life force. The machinist may construct a compass for the mariner. He makes his handle of steel, but without the subtle power of magnetism it is useless for the purpose intended. The electrician may store electricity in a Leyden jar, but such a jar is not electricity. He may approach a pointed steel to one of the knobs, there is a flash, and that subtle power which was stored within is gone in an instant. As a jar is not electricity so the physical body is not life. Life is a force, which under certain conditions takes hold of matter and moulds it into the physical forms of our bodies, and the so-called living forms which we see around us. The chemical affinities of matter are the playthings of life force. The molecule is torn asunder and compelled to reform with different groupings of the elements of which it was composed, that our bodies may be formed of their constituents. The roots of plants taken up mineral substances from the earth. The blades attract the elements of the atmosphere, and the grain has formed through newly acquired affinities and a peculiar combination of the elements. The grain is taken into the stomach, and a process at once begins by which its elements are torn

asunder and compelled to recombine in other molecular forms for the construction of our bodies. In the chemical laboratory of the life force, the elements of earth and air become grain—the elements of grain become man.

It will be your business while here to study the phenomena of life, and the conditions which are favorable or unfavorable to their maintainance. This is the business of all medical students, no matter what their specialty. The central ideas are the same for all; no matter whether the principal practice be to amputate the shattered limb for the soldier, or to remove the carious portions of the teeth for the soldier's child. Each is striving in his special field to maintain the best conditions for the continued manifestation of life, and the comfort of the individual, under the special conditions in which he is called upon to act. Each strives to remove that which is hurtful, and place the diseased or injured parts in the best condition for future usefulness. To this end we study anatomy and histology, that we may know the structure of the different parts. To this end we study physiology and hygiene, that we may know the functions and relations of the various organs in their healthful play, the surroundings and the food best calculated to promote continued healthful action. We study chemistry that we may attain a better insight into the composition of living structures; that which may serve as foods and medicines; and that we may ward off the dangers of contact with hurtful substances.

By the study of pathology we learn to quickly appreciate deviations from health. These are presented in the utmost variety of form, and require much patient labor for their mastery. You will find in the prosecution of your labors that the laws of disease are in many respects as definite as the laws of physiology, but often even more subtle and delusive. Disease being founded in the disturbance of physiological action, to know the former we must know the latter.

By the study of therapeutics we are enabled to apply to the cure of disease those remedial agents the nature of which we learn in the study of materia medica. All these subjects are blended together in the most intimate way. No one of them can be completely divorced from the other. All are of equal importance to the student of medicine, no matter what his special field of practice. These studies form the basis of the medical knowledge of

every intelligent practitioner, whether he be surgeon, general physician, gynecologist, occulist or dentist. Specialties in the healing art do not rest upon differences in the basic facts upon which they are founded, but upon the same fundamental truths; hence, the studies are in a large measure the same for all. An inflammation of the mucous membrane of the mouth may not differ essentially from inflammation of the mucous membrane elsewhere. Again,an inflammation of the knee joint may not differ essentially in its character from an inflammation of the peri-dental membrane; but the localities and structures involved are widely different, and the manipulative and surgical treatment in the two cases must be varied to suit these differences. It is upon the difference in the location of disease, the difference in the structures involve the manipulative application of drugs, and the surgical means employed, that specialties are for the most part founded. Except in the manipulative sense the differences in the application of medicine to the cure of disease has hardly proved a sufficient foundation for a specialty. Hence all the successful specialties are founded in a large measure upon manipulative or surgical treatment. It is only in the more limited sense that specialties in which surgery is not extensively employed have succeeded. The specialist in diseases of the mind would not succeed but for the fact that his patients are gathered together in large hospitals under State management. A few men by devotion to one special line of study, pursued rigidly, succeed in building up a special practice; as has occasionally been seen in nervous and mental diseases, diseases of children and the like. These specialties, if they can be so called, depend for their existence upon the person, the peculiar devotion to this special field of study, and the energy in action to create them, and usually die with their author.

The specialty of gynecology, however, is very different and will grow in importance as a specialty instead of diminish. It does not depend upon the superior power and the insight of an individual, but has grown out of the necessities of the human family and the peculiarities of the surgical manipulations found best adapted to the cure or alleviation of diseases of the peculiar organs with which it deals.

The specialty of the occulist is of a like nature. It was not until the adaptation of instruments for diagnosis and surgical means requiring special dexterity in application that this specialty rested

upon a firm foundation. It could never obtain such a general sanction from the medical profession upon any possible theoretic differences in the administration of medicines, for the simple reason that these differences do not exist in nature, and therefore can not exist in matters of practice.

The specialty of dentistry does not differ from these. It also owes its existence to the peculiarities of manipulation rendered necessary by the surgical means found best adapted to ameliorate or cure the diseases of the teeth and associate parts. And it is only on the basis of these necessary manipulatious, and the amount of time required for the development of the necessary skill in their performance, that we find any sound basis for the existence of any of these specialties. They cannot be founded on special knowledge of disease, and the adaptation of medicine to their cure. This class of information belongs to the medical profession as a whole.

I would not have you understand from these statements that the general practitioner must know *all* the special phases of diseases of the eye and the special adaptation of drugs for their alleviation that may he known to the occulist. By no means. We expect the specialist to expand in his own particular field, while the general practitioner gives his attention more particularly to his line of practice. This is true and should be true in all specialties of medicine, but it involves no difference in the fundamental doctrines of medical science in these various fields. Hence, the principal studies presented to the student who is preparing for the practice of the specialties, are the same as those for the general practitioner. One other reason exists for the formation of specialties in medicine, and that is the extreme frequency of forms of disease requiring special surgical manipulation. If we examine the well-established specialties, we will find in every case that the diseases treated occur with great frequency as compared with others. This is true in gynecology. It is true in diseases of the eye and ear, and it is pre-eminently true in the diseases of the teeth. Therefore, our specialty is more firmly founded upon the needs of humanity than any other. The gynecologist rarely devotes himself exclusively to his specialty. The occulist is found only occasionally outside of the larger cities, but the needs of the human family for the dentist have made him almost omnipresent. The town is small indeed that will not support one or more dentists. This is explained by the great prevalence of the diseases of the teeth.

Therefore, we find the dentist confining himself exclusively to his specialty, as a rule.

It must not be supposed that because a specialty in medicine rests in a large degree upon dexterity in certain surgical manipulations that this dexterity constitutes the medical specialist—far from it. Of what avail is an elegant operation upon the eye if that operation be not well adapted to meet the pathological state which it is intended to ameliorate or cure? Of what avail is a mechanically skillful operation by the surgeon if from lack of knowledge of pathology it is misdirected? So the mechanically skillful bnt ignorant dentist may make splendid operations upon the teeth to the injury of his patient, because of inability to form a correct judgment of the pathological conditions. Therefore, manipulative ability alone does not constitute a medical specialist. Without the knowledge that will enable him to diagnose clearly and apply his dexterity wisely to the alleviation or cure of pathoiogical conditions, the man remains the veriest quack, be he ever so skillful a manipulator. Neither can we neglect the administration of drugs, for by these we supplement our surgical means of cure, and in very many cases this means of cure stands first in the list of remedies, the surgical being inapplicable or holding a subordinate position. In the years past it has been the reproach of the specialists that their practitioners failed in the handling of drugs. Why? Simply because they were not good, patient, medical students, and had not learned sufficiently well the virtue of drugs, nor gained the ability to diagnose with sufficient clearness the pathological states to which they were applicable. This was true among occulists, and has been especially true among dentists. Let me express the hope that before each of you go out of this institution to practice your specialty, you may be prepared to do your full share towards the banishment of this reproach. Very mnch of the time of the dentist must,in the very nature of the diseases he is called upon to treat, be given to delicate and tedious manipulations, and it should be the aim of every dental student to become very proficient in this branch of his art; but in doing this he must not neglect the close study of disease, and the remedial virtue of drugs. Young men are too apt to be carried away by the brilliancy of splendid operations, and neglect studies that are of more intrinsic value. Although so much of the time of the dentist is occupied with manipulations, he should *know first, do second.* The future reputation of

each one of you will depend more upon what you have in your mind, than upon what you can do with your fingers. The specialty in medicine grows up to meet the want felt by the people. It cannot be founded upon the desire of the individual. It is the people whom we all serve, and within certain limits we must so shape our lines of practice as to meet these needs if we would be successful. This does not consist however, in a slavish obedience to the popular will. The specialist should not lose his individuality and be turned aside by the false views or whims of those whom he serves. It is rather his business to obtain such a knowledge of the needs of those who consult him, and rise to such a degree of individuality and firmness of character, that he may have the power to control his patients and lead them into that course and action that will best meet their needs in each individual case. Here the specialist is not only the dexterous operator, but also becomes the teacher, and must by his council and advice lead the erring into such habits of life as will best promote their physical and mental welfare, and prevent the occurrence of disease. Skill in this line of work is just as important to your future success as dexterity in manipulation.

Every young man in entering upon a profession which shall constitute his life work, is impelled to the choice by some motive more or less strong. We take it for granted that every young man has some object before him that he wishes to attain. Some will strive for wealth, and perhaps a large number start on their life work with this end in view. Others may desire fame more, and are anxious to build for themselves a name among men, believing that after this is attained a sufficiency of this world's goods will follow. Some of you may have chosen the dental profession with the idea that it will furnish you a living with less labor than other professions. And some of you may have made this choice with the idea that you possess the natural dexterity which renders you especially fitted for the delicate manipulations so much required in this specialty. So it is that some enter this profession from one motive and some from another; but all desire success, and we presume are willing to give their best efforts to secure the object sought. A firm determination of this nature is certainly to be commended in every student. After years of experience in this specialty and a fairly wide observation of men in other avocations, I may be presumed to know something of the proportionate returns for the mental and physical energies expended. The capital invest-

ed by the dentist is that which he lays up in his brains and hands. Of dollars and cents he needs but little, and that little can often be supplied by his friends. But in obtaining that store of knowledge which alone furnishes the capital that determines his success or failure, he must rely mainly upon his own industry and obtain it by patient toil. Friends may assist by placing the matter properly within his grasp, and let me say that the Faculty of this institution will devote their best energies to this work.

In my observation of men it has appeared that dentists have won for themselves as fair a share of this world's goods, when compared with the capital, knowledge and energy invested in the business, as has fallen to the lot of men in other pursuits. The dentist who is well fitted for practice, and has a fair personal address,rarely fails to make a reasonably good living. Some very well informed men fail, but it is usually to be explained by some mistake in location or equipment, but oftener from errors of personal conduct. Those who attain wealth rapidly are comparatively few in any profession, and dentistry is no exception to the general rule. Yet there are examples enough to show that the dentist may accumulate wealth with considerable rapidity; but, at the same time, it must be conceded that dentistry is not the profession for a man to chose whose principal desire is to obtain great wealth quickly. Those who enter this profession with the desire to attain great fame had about as well retire at once. But to those who wish to be known as men among men, and attain a good name in society as persons who are doing their full share for the welfare of the human race, I would say go directly forward with the course you have chosen. We want you with us, and can promise you that you will find ample room for development. Your opportunities for good will enlarge as you progress in your professional work, and an appreciative public will reward you. While dentistry may and does require of those who do their duty in its practice much hard and patient toil,and much that is discouraging at times, it has pleasant features. The dental practitioner if he manages his time wisely may have as many hours for undisturbed relaxation as the devotee of any other profession. It is rapidly becoming the custom of the members of this profession to establish their hours for office work, and have some time that they can call their own, in which they can go forward with such studies as may be desirable and pleasant, each one following his taste. Or the dentist can devote, if properly and temper-

ately done, much time to the pleasures of society, cultivating friendships, giving and receiving visits If his tastes incline him in that direction, he can give much attention to the study of science, art and literature. Let me say also that directly in the line of his profession there is yet a rich field open to exploration and discovery. The dentist, or indeed any other medical man, be he general practitioner or specialist, need not want for fields of research for many generations to come. No field of research has been more enriched than ours during the present century, and the prospect for finding other and still more brilliant treasures in the years to come is brighter than ever before. It is entirely unnecessary that I point toward special fields that are now in sight. A sufficient number of them will rise up in the path of the earnest student, and his time may be well spent in legitimate lines of investigation that will give a rich reward to his diligence and perseverance.

In your work while here in this College, the Faculty will expect of you punctual attendance on the several lectures, and constant diligence in the Infirmary and Laboratory. You will have but little time to play during your course here. The time required of you is very short when considered with reference to the work you are expected to accomplish. Indeed many of us who have been long in this field of work feel that it is much too short, yet the work seems to be demanded within the time set apart, and it will be your duty to make the best possible use of it. In the meantime, the several members of the Faculty will do their best to excel you in their promptness and devotion to their part of the work.

GOLD FOR FILLING TEETH.

BY W. O. KULP, D. D. S., DAVENPORT, IOWA.

Read before the Iowa State Dental Society, May, 1884.

The subject of filling teeth with gold has been discussed and *cussed* for more than fifty years, in journals and in societies, by the dental chair and in private conversation, until we can well say; what more can be said, what more can learned?

In fact, this subject has a strange power of infatuation.

The student does not become so enthusiastic over any other

part of his professional acquirements as when he sees his first glittering contour gold filling. He will call up the entire class, individually, and show off his triumph, and he will at once strike a cord of sympathy in the minds of all. It is not a strange thing to see a young and even an old operator so absorbed in a fine gold filling that he will not notice hunger or weariness; in short, the amount of untiring energy put forth uncomplainingly with this class of operators is simply amazing. What would become of our specialty if it were not for this stimulus? I fear it would finally sink into a sort of humdrum, don't care calling. For my own part, I believe I would hardly care to remain in the profession if I were forbidden to fill teeth with gold. But is this stimulating impetus the only reason why we advocate filling teeth with gold? I answer not by any means. After an experience reaching over twenty-five years in attempting to save teeth by filling with gold, and during that time giving due experimentation to all other materials that have been thrust before us, I must give my testimony to-day, most emphatically, in favor of gold, as being the most absolutely perfect material (with the single exception of color) yet given to the profession, as a means of restoring and preserving decayed teeth.

Let us see what is necessary in a material to be used for this purpose:

1. Purity. Not liable to affect the general health, by giving off particles of its own substance; not to be affected chemically by coming in contact with food or medicinal agents, and thus combining and giving off an injurious *element*.

2. Adaptability to the walls of the cavity so as to effectually exclude air and moisture from the cavity.

3. Imperishableness. Able to endure mechanical friction and be insoluble in the secretions of the mouth, or chemical agents taken into the mouth. Gold has all the above qualities in completeness.

4. In color of tooth structure it is a failure; still, a well finished, soft gold filling kept clean does not look badly, much better than any other durable material yet given us.

As to its electrical harmony with dentine or tooth substance, I have no sympathy with the position taken by the advocates of the new departure on this point, my experience and observation never having revealed any such condition assumed by them to have

been discovered. Neither do I believe that gold and amalgam or other material when put into the same tooth and in the same cavity do any harm to each other, or the patient, or the tooth substance. I have seen a great number of such cases doing well after many years' service.

I have special reference to repairing gold fillings with amalgam. I see such cases of repairing, after over twenty years' service, still in perfect condition, even in teeth that were considered at the time of repair too frail to again be filled with gold. Our limited knowledge of chemical laws and affinities often misleads us in our attempts to weave out some finely spun theories.

Hence, years of experience do not always agree with what some fellow has spun out and published in a book or pamphlet, or said at a society meeting.

I do not want to be understood as being an advocate for using mixed materials for filling teeth, but that I would not hesitate to repair a leaky gold filling in a molar or bicuspid with amalgam.

I do not intend this paper to be understood as advocating any new method of filling teeth with gold, but it may be of interest to some of the younger members of our society to listen to a review of the different modes of using gold for filling teeth.

1. Within my personal recollection gold was folded in strips of one-fourth to one-half leaf each, and sometimes whole leaves and even two and three leaves, if the cavity was very large, and then these strips were placed in the cavity, fold after fold, until it was about three-fourths full, when the folds were packed against the walls, instead of into the bottom, leaving the gold projecting enough to condense and still leave the cavity over full. This was about as difficult a method as any since employed, but made excellent work if well done.

2. Was what is called cylinder filling, where the gold folded as before, was rolled upon a broach, until it formed various sized cylinders. These were placed upright against the walls of the cavity until they were well protected, when the wedging process began from the centre of the filling in every direction, and more compact cylinders were placed in the space so made. This process continued until no more space could be made, when the filling was condensed with burnishers and finished. Many became quite expert in this manner of operating and many fillings put in after this mode may still be seen in the teeth of old people. I removed one the other day that had done good service for over forty years.

In this operation the stickiness of the gold, as it was then termed, was a serious objection. We often allowed the filling to get wet with saliva to overcome it. How often I feel like saying "fool that I was to puzzle and sweat trying to overcome what has since been my best friend! viz., the cohesive property of gold.

3. Came the nugget plan, which consisted in squaring the walls of the cavity as much as possible, and then folding and rolling gold foil into a hard mass, just a trifle smaller than the cavity to be filled, but about one-third higher than the depth of the cavity, thoroughly driving it home, depending on the battering out of the gold to fill the entire cavity, and leave a surplus for finishing off. In this operation I used the tack hammer (quietly) long before the mallet was in use! I was ready to say, God bless you! to Dr. Atkinson when he publicly advocated it in filling teeth.

Next came the sponge and cohesive gold era. In this era more teeth were wrecked and more suffering inflicted upon humanity than before or since. Not that I would be understood to say that no good work was done with cohesive gold—not by any means, for each have living specimens of success; but as a general rule making a hard ball of gold in a cavity was done at the sacrifice of thorough adaptation to the walls of the cavity, and thus many teeth were sacrificed, and many well-meaning men cursed by suffering patients. Gradually the older practitioners found that heavy foils did not save teeth as did some of our earlier operations with non-cohesive gold and lower numbers. One by one operators went back to Nos. 4 and 6 cohesive gold foil, and finally, to-day, there is more non-cohesive gold No. 5. used by the profession than ever before. This is made into pellets, balls, blocks, and ropes, and then annealed as it is used, thus making it as cohesive as desirable, as the work progresses towards contouring. Thus the old time method of filling cavities with soft non-cohesive gold, and the later one of building out with cohesive are combined until there seems to be no further room for improvement. We will find that this era will be called the successful one, as compared with all the past. As to the future, we must expect new things, new instruments and new modes of condensing gold. We have already found the true forms to be employed. If we can only find some way to get it into the cavities without so much pounding and hammering, our patients will call ns blessed. Whether we can expect much of the

Herbst method is yet to be demonstrated; while at present I cannot see its possible adaptability in all cases, I believe it to be a step in the right direction, and that the time is not far distant when new light will be revealad to some one and hammering will be comparatively obsolete. That it may soon come the profession and suffering humanity will pray and ever pray.

TRANSLATIONS.

ON THE HISTOGENY AND HISTOLOGY OF THE DENTAL ORGAN.

FROM PROGRÉS DENTAIRE.

After all that has been written by excellent French and German authors on the histology and histogeny of the dental organ, it may perhaps appear superfluous to recur again to this subject. My only purpose is to collect in a few pages all that, up to the present time, is known of the development and structure of the tooth.

It is less an original work than a simple résumé.

Part I.

ORIGIN AND FORMATION OF THE TEETH.

Of the numerous phenomena of the human body, none, perhaps, is more curious and more interesting than that which concerns the development of the tooth. Obedient to certain laws of nature this development begins about the sixth week of uterine life with a perfect regularity, and continues to complete maturity, but in a manner so secret that the most minute investigations, undertaken to discover the means by which it was accomplished, had for a long time no result. Nevertheless, to-day we have seemingly arrived at sufficiently precise ideas of the progress of this development.

The teeth are developed progressively from minute papillæ, visible at a very early period of the fœtal life, and situated in a groove lined with mucous membrane and running around the alveolar border of each jaw. In proportion as they increase in volume, the papillæ take the form of the crowns of the various classes of teeth

which they are respectively destined to produce. Having reached this period of their formation, they begin to undergo dentification, at first at the cutting edges of the incisors, the points of the canines and bicuspids and the tubercles of the molars; the process is then continued over the whole surface of their crowns until it has completely enveloped them. Thus it is that, layer by layer (the new formation being enveloped by that previously formed), the entire solidification of the teeth is accomplished.

Before this process has far advanced, however, the formation of the enamel is begun, and this operation is finished even before the dental pulp has become completely dentified. At the same time,and as it were in anticipation of the loss of the temporary teeth, there is formed a secondary series of teeth, and when the former are shed, they are promptly replaced by the permanent organs. Thus, by an admirable provision of nature, the first series of teeth, intended only to supply the wants of infancy, at a period when the jaws are too small to receive organs like those of the adult, disappears, to be replaced by a series larger, denser and more numerous.

At about the fifth month of uterine life new follicles, containing the rudiments of the permanent teeth, are already situated obliquely beneath the germs of the milk teeth. Later, these follicles fall back and down, and at the same time take a vertical position. Their ossification takes place little by little during the early years of life, although they still remain for a certain period connected with the temporary teeth by means of a minute, long and slim cord. This cord, known also to the ancient odontologist, is called by Delabarre "appendix to the dental matrix," and is generally named "ter dentis." The histogenic phenomena are the same for both dentitions.

The mode of development of the teeth, as I have thus briefly explained it, is admitted by all anatomists; but a grave question has been raised, bristling not only with difficulties but with controversies, and for which various solutions have successively been proposed; it is the question of the genesis of the different tissues that enter into the composition of the tooth. I do not pretend to resolve in a definitive manner a question so important and so difficult; I will only endeavor, with the aid of recent works of the best authors (yet without desiring to enter into the field of controversy) and with the examination of a few microscopic prepara-

tions which I have prepared with this intention, to make at least a little clearer this obscure portion of the animal histogeny.

The ancient authors attached no great importance to the knowledge of the first phases of the evolution of the tooth, which is the reason that this part, so beautiful and interesting, of the anatomy of its development has remained till to-day almost unknown. Nevertheless, we should not refrain from mentioning those of the ancient anatomists who occupied themselves with this subject; the first was Eustachius, who, in 1563, noticed the disposition of the teeth in the jaw before their eruption. Nevertheless, his investigations were limited to observations on the human jaw after birth, a period at which he claimed to have discovered, by skillful dissection, the incisors, the canines and three molars of the two sides of each maxillary, in a condition partly gelatinous and partly solidfiied. He discovered also the permanent incisors and canines behind the temporary teeth.

After Eustachius, others attacked the the subject: John Hunter, Jourdain, Blake, Fox, Serres, Delabarre and others, but their investigations threw no light upon it. The Englishman, Goodsir, has the merit of formulating a theory of the development of the teeth based on observations made upon embryos of six to seven weeks; if this theory has been overthrown in our days by the works of modern histologists, yet for a long time it held its ground in opposition to all others. According to the opinions of the more recent authors, the development of the tooth begins with the formation of the dental germ. This germ is composed of three distinct parts which are, according to the order of their appearance, the adamantine or enamel organ, the dental papilla and the dental sac.

The dental papilla which appears at the bottom of the dental sac, is composed of two parts: a median or axis formed of a connective substance containing vessels and nerves; an external, called also membrane of the ivory or dentine, formed by juxtaposed cellules, covering the central portion of the papilla after the manner of an epithelium, "dental cellules". Moreover, some authors describe a limiting exterior membrane, "the preformative membrane" of Rashkow, which separates the dental papilla from the enamel organ. This is not generally admitted, for the membrane in question appears to be simply an a tificial product.

The enamel organ forms a sort of hood whose concavity caps

the top of the dental papilla, and whose convexity meets the inner face of the dental sac. It follows from this that the enamel organ is composed of three layers: an external epithelial layer which on its face presents prominences with which the vascular excrescences of the dental sac engage. These villous projections, presented by the internal surface of the dental sac, were first described by English authors, Goodsir, Huxley, Todd and Bowman, and more recently and with greater exactness by Robin and Magitot. According to them, the villosities are pointed towards the superior face of the enamel organ, and correspond to the ordinary vascular papilæ of a mucous membrane. Soon after there is developed a capillary net work which receives the blood from the maxillary and the gum, and finally, the follicular walls disappearing, it forms vascular loops in the villosities before mentioned. Within the external layer lies the middle layer or pulp of the enamel, of a gelatinous appearance, whose internal cellules form the intermediary membrane of Hannover or matrix of the enamel; finally, there is the internal epithelial layer or enamel membrane.

The enamel organ and the dental germ are joined to the buccal epithelium by means of a prolongation called the gubernaculum dentis. Of the three parts thus forming the dental germ, that which appears first is, as we have said, the enamel organ. The mechanism of its formation is as follows:

From the eighth to the ninth week of inter-uterine life the buccal epithelium, which fills the dental grooves of the two maxillaries, is formed of three layers of cellules. Those of the first are pavimentous; those of the second, smaller and more rounded; and, finally, those of the third layer, cylindrical. At the moment of the formation of the dental germs the epithelium shows an elevation or ridge called by Kœlliker the dental crest.

At this stage the dental papilla begins to be formed, and appears as a bud, which, springing from the mucous tissue, is capped by the mucous portion of the enamel organ; we find also at this period the first traces of the dental sac, a simple condensation of connective tissue of the mucous derma around the enamel organ. At a more advacned period the cap of the enamel organ is fairly outlined. The cylindrical cellules which bounded its exterior have assumed different characteristics according as they are in contact with the sac or with the dental papilla. The former, which are the smaller, become pavimentous, and are covered with budlike

prominences ; the latter remain cylindrical, and constitute the enamel membrane. The rounded cells of the centre are gradually changed into a kind of mucous tissue without vessels, sown with star-shaped cellules, and form the enamel pulp. The innermost cells of this intermediary layer alone preserve their primitive character and form the intermediary membrane of Hannover. The pedicle which unites the enamel cap to the dental crest becomes then the true gubernaculum dentis. The enamel organ is therefore entirely of epithelial origin.

I have already said that the dental papilla is composed of two parts, an external and an internal ; the external part is destined to produce the dentine which is developed at the expense of the cylindrical cells of its surface. These cells have spindle-shaped prolongations which are transformed into dental or Tomes' fibrils. Finally, in the midst of these fibrils, appears a homogeneous substance whose production is analogous to the intercellular or fundamental mass of the connective tissue. This intermediary substance undergoes diffuse calcification, transforming itself into a dentine or ivory. This transformation resembles greatly that of the osteoid tissue, so that we may say that there exists between them bonds of relationship. The walls of the dental canaliculi are formed at the expense of the layers of fundamental substance, and limit and envelop the fibrils of Tomes. The progress of this development is very difficult to follow. I will, however, endeavor to state all that in the present state of the science appears to me positive. According to Lent and other observers, the cellules of the dentine throw out little by little the filliform prolongations we have previously mentioned, and which attain a considerable length ; these prolongations finally anastomose by means of their branches, preparing thus the way for the dental canalculi. Ordinarily each cell has but one prolongation, yet some of them have two. The calcification of which we have spoken above begins at the summit of the germ of the dentine, in the form of one or of several thin plates, separate, and known as the dentinal cap. This calcified layer covers, little by little, the germ of the dentine, spreading over its sides, from above downwards, and from within outwards.

At the time when this calcification is beginning, the vascular network, which is found at the centre or axis of the dental papilla, attains its entire development. At the same time, the cellules of the dentine, situated beneath its summit, undergo the changes experi-

enced by their predecessors; that is to say, they become transformed into Tomes' fibrils with the dental canalculi and the fundamental substance. This latter soon undergoes a new calcification, from which it results that the germ of the dentine, always smaller. is extended gradually in length. This extension of the germ of the dentine gives rise to successive formations of the root, which undergoes at all points changes identical with those of the crown, changing into dentine and becoming calcified at the periphery. From this it follows that the portion of the dental papilla which is not transformed into dentine, constitutes the dental pulp.

After the appearance of the dentine, each disk of dentine is covered with a minute cap of enamel. The production of enamel takes place between the dentine and the enamel membrane; consequently beneath this membrane, by a mechanism still obscure.

Each enamel prism seems to correspond to a cylindrical cellule of the enamel organ; these cellules are calcified from the centre to the periphery, and the transformed cellules are replaced by new cylindrical cellules proceeding from the intermediary membrane of Hannover-cellules destined to calcify in their turn. The deposits of the layers of enamel are made then from the interior to the exterior ; consequently, in a contrary direction to the deposits of ivory. The pulp of the enamel insensibly disappears and the external membrane of the enamel organ constitutes the enamel cuticle.

The cement which covers the root of the tooth is formed, as are the periosteal deposits of the bones, at the expense of the internal wall of the sac which becomes the alveolo-dental periosteum. The production of the cement precedes but slightly the eruption of the teeth. In confirmation of what I have said of the origin and the formation of the teeth, I think it useful to reproduce here the conclusions to which Legros and Magitot arrived some years ago.

1. The first trace of the dental follicles appears in the form of a cord, arising from the epithelial layer of the mucous membrane of the gum.

2. The cord which gives origin to the follicles of the first dentition springs directly from prolongation of the buccal epithelium. The cord of the permanent teeth which succeeds the former is a diverticulum from the primitive cord. As for the follicles of those permanent teeth that are not preceded by corresponding temporary teeth, they spring either from the mucous membrane or from the cord of the preceding molar, according to the kind of tooth.

3. Whatever its point of origin, the cord is invariably epithelial; it is composed at the periphery, of the prismatic elements of the layer of Malpighi (the rete mucosum), and of the polyhedric epithelial cells at the centre.

4. The extremity of the cord, which soon takes the bud-like form, constitutes the organ of the future follicle.

5. The dental bulb appears spontaneously in the midst of the embryonal tissue, and covers directly the curve of the epithelial cord.

6. The enamel organ and the bulb cover and model themselves one upon another; the first serving as cap for the second, relations which are found at all periods of their evolution which precede the appearance of the dentine and of the enamel; that is to say, of the future crown.

7. The follicular wall is the direct emanation from the bulb, from which it detaches itself to rise on the sides as far as the summit of the follicle, where, joining itself again to the wall, it constitutes the follicular sac.

8. The rupture of the epithelial cord corresponds to the closure of the follicle, and from this moment the follicle loses all connection with the mucous membrane. The follicular formation is then free.

9. The evolutional phenomena of the follicles, to whichever dentition they belong, are identical in their nature. The only differences that exist are at the exact point of the origin of the epithelial cord, and in the time which the successive phases of their evolution require for the accomplishment.

10. The mode of genesis of the follicle of the tooth and that of the hair-producing follicle are identical.

ERUPTION OF THE TEMPORARY TEETH.

When the crown of the tooth is completely formed and covered with enamel (which is the condition of things at birth) and when the root which is growing longer touches the bottom of the alveolus, the tooth, which is arrested by this impassable barrier, is necessarily carried slowly and by degrees towards the gum, by the fact of its natural growth.

The most diverse opinions have been given on the mechanism of the eruption of the teeth. Some authors attribute it to the lengthening of the root; others to the pressure of the alveolus upon the

root, driving the tooth towards the gum; others to a mechanical action of the crown which destroys the tissues lying beneath it. Finally the elder Delabarre compares the eruption of the tooth to the birth of a child. According to him, it is the dental sac adherent to the gum at one portion and to the neck of the tooth at another which, by its contraction, is the principal agent of the sortie of the tooth across the dilated orifice of the sac.

In the face of such hypothesis, I will only say, with the majority of physiologists, that the principal cause of the eruption of the teeth is solely the gradual pressure which the completely developed tooth exercises on the enamel organ and on the summit of the follicule, which soon give way, as well as the portion of the gum that covers them. As to the order of the appearance of the teeth beyond the gum, although no rule can be stated which will always hold good, I will nevertheless give a rough statement thereof.

According to many authors, the milk teeth erupt in groups and in a pretty regular order, the first comprising the two inferior central incisors, the second the superior incisors—the centrals first, then the laterals; therefore, when a child has six teeth, he has four above and two below. A third group comprises the two inferior lateral incisors and the four first molars. A fourth, the four cuspids or canines, and finally a fifth group, the four second molars. This order must not be considered as absolute, for there are many exceptions. The superior central incisors, for instance, may appear first, and sometimes their eruption takes place at the same time with that of the inferior incisors; at other times, the evolution of the first molars precedes that of the superior incisors. Bnt these exceptions are rare, and the order of eruption given above may be regarded as the rule. As for the period when the eruption of teeth occurs, it is difficult to place it with any accuracy. Children are sometimes born with teeth, while others do not get their first tooth till about the twentieth month or even later. Between these two extremes, there are found every variety of intermediate epochs. In a general way, it may be said that the first tooth appears about the seventh month of the infantile life.

LOSS OF THE TEMPORARY AND ERUPTION OF THE PERMANENT TEETH.

At the epoch of the complete evolution of the temporary teeth, the permanent teeth which are to replace them already exist in the jaws. They are arranged in a manner sufficiently regular,

but different, according to the kind of teeth. If we examine at the the proper time a young jaw, there will be noticed behind each temporary incisor and canine, a minute point to which the name, *iter dentis*, has been given, because it indicates the spot from which will issue the permanent tooth. This point is the termination of the fibrous and vascular cord (*gubernaculum dentis*) which joins the follicular envelope of the permanent tooth to the neck of the corresponding temporary tooth. The *iter dentis* exists also for the permanent bicuspids, which are to replace the temporary molars, but is placed beneath the crown and between their roots.

As for the *gubernaculum dentis*, it is made to play an important *role*, it being regarded as the principal agent which guides the tooth during its process of eruption. The fact is true, but the diverse explanations which have been given seem to us far from conclusive. The gubernaculum, indeed, gives the tooth its direction, but not by drawing it as would a cord which contracts upon itself, or indeed by its dilation affording the tooth a passage as some authors have thought. According to a distinguished author, it acts by yielding its place in proportion as it fulfills its absorbent function, and perishes by a sort of self-destruction. In fact, we have seen in our account of the first dentition, that this cord (gubernaculum) was only the prolongation of the dental follicle, and that it was metamorphosed into an absorbing body (fungus of Delabarre), destined to open a passage to the erupting tooth. The same is the case for the second dentition. This fungus, which is still more voluminous, destroys little by little, as it forms, the parts in its neighborhood and, among others, the alveolus and the root of the corresponding tooth, thus making a place for the tooth beneath the fungus. The alveolo-dental periosteum, as well as the pulp of the temporary tooth, which is about to fall, become themselves parts of the absorbent body, and the root disappears, leaving its crown all ready to be detached.

Notwithstanding the authority of such authors as Delabarre, Fox and Bell, who have supported this opinion, I believe there is no necessity for the fungus of Delabarre to explain the mechanism of the loss of the te nporary teeth and the coming of permanent ones.

The germs of the permanent teeth are, as I have already said, situated behind those of the milk teeth, and make their appearance the third month of uterine life. As the germs increase in

size, they compress the vessels and nerves of the milk teeth, and, thus arresting their development, finally lift them and force them from their sockets.

Such, it seems to me, is the mechanism of the eruption of the permanent and the loss of the temporary teeth in their normal state. But it may happen that the germ of the permanent tooth is not situated where it should be, which we have previously pointed out; then the pressure by the coming tooth upon the milk tooth does not take place, and the two teeth exist the at same time in the jaw. In this manner are produced irregularities, and sometimes even a double denture, with a deformity more or less pronounced.

The teeth of the second dentition,properly so-called (the molars), erupt exactly in the same manner as those of the first dentition. The shedding of the temporary, as a rule, follows the exact order of their eruption. When the teeth of one group have been shed, there is allowed time enough, before the loss of another group, for the corresponding permanent teeth to take their positions. The eruption of the teeth of the second dentition begins almost always about the sixth or seventh year and is completed at from the twenty-second to the twenty-fifth year.

[TO BE CONTINUED.]

SELECTIONS.

CAUSES OF DISCOLORATION IN GOLD FILLINGS IN TEETH.

BY WILLIAM HERBERT ROLLINS, D. D. S.

As pure gold is not supposed to discolor, the causes must be other substances which may be introduced in one or more of several ways: they may be present in or on the gold foil when received from the makers; they may be present in the mouth itself.

The best way to begin the investigation was evidently to collect the discolored portions of fillings and analyze them. As yet no satisfactory result has been reached in this way, because the quantities were too minute.

The fillings themselves were next examined. Iron, silver, tin, and mercury were found. In which of the ways mentioned did these metals get into the fillings? The first attempts made to answer this question were to get samples of gold foil from the prom-

inent makers, number them, and send them to Dr. Hills, of the Harvard Medical School, to be analyzed. The results of these analyses showed that none of the samples were pure. This was unexpected, as the makers guarantee their foils to be one thousand fine, or absolutely pure. Silver was found in every sample and iron in some. Extensive analyses made by the same chemist a year later showed the same results. The gold prepared by R. S. Williams always contained the least impurities. As the gold when received from the makers was always found impure, a short description of the manufacture may be of value as showing how impurities may be introduced.

The gold out of which foil is made is the mint gold, containing about two parts in a thousand of impurities. The makers dissolve this in aqua regia, filter, precipitate with ferrous sulphate, or more rarely with oxalic acid, wash the precipitate, melt it, and after casting, roll to ribbons between steel cylinders. It is then beaten to the required thickness between pieces of glued skin, which are never clean.

Gold in this form I shall call plain foil, to distinguish it from the forms in use. Plain foil is not in the market. It must be obtained by special order. To get this plain foil into the numerous varieties required by those who fill teeth, it passes through several processes and then becomes soft gold, cohesive gold, gold cylinders, gold blocks, gold pellets, etc., etc.; indeed one maker advertises over fifty varieties.

Cohesive Gold. Plain foil is heated (usually on an iron plate).

Soft Gold. I am not sure how this is made, as makers of foil have their secrets, but as surface impurities have been found on this kind of foil it is probable that, in some cases, the softness is due to those impurities which prevent two surfaces of this gold from uniting, and thus produce the so-called softness.

Corrugated Foil. Alternate sheets of gold and thin paper are made into a pile, placed between two pieces of iron and heated in a furnace till the paper is consumed. The sheets of gold are then separated, the ash of the paper removed as much as possible, after which the leaves are placed in books, or used in the manufacture of gold blocks, gold cylinders, gold ribbons, etc., etc.

Gold Blocks, Gold Cylinders, etc. These are the forms of gold in most general use. To make them the foil (usually the corrugated kind) is subjected to various rolling, pressing, and cutting processes by iron machinery.

This brief description of the manner of making gold for dental use enables us to see how easily impurities may be present in the finished product.

Silver, which is always present in the gold before refining, is almost sure to be present after the process, through careless manipulation and poor acids. Iron is likely to be introduced from the ferrous sulphate, from the mould, from the steel rollers, from the plates on which the gold is heated,from the hands,from the machinery used to form it into pellets, cylinders, etc. Other impurities are almost certain to come from the skins used in beating, from the paper used in corrugating, and from the dust of the shop.

To test whether impurities could be introduced by a careful person in making fillings, the following experiments were tried. The foil used was plain foil, and contained no impurities except a small amount of silver, as shown by a very careful analysis by Dr. Hills:—

First experiment. The foil was prepared in the ordinary way, as follows: It was cut with steel scissors, heated on iron, handled with steel tweezers, condensed with serrated steel pluggers, burnished with a steel burnisher. Dr. Hill's analysis showed that iron was present in these fillings.

Second experiment. The same foil was treated as before, only iridium instruments, made by the American Iridium Company of Cincinnati, were used instead of steel. Iron was found in these fillings.

Third experiment. The same foil was cut with bamboo, handled with gold tweezers, heated on platinum and condensed with iridium points, and burnished with an agate burnisher. No iron was found in these fillings.

This brief description can give no idea of the amount of care and time which has been spent on these investigations. I give a short abstract from one of Hill's reports, but even this conveys no adequate idea of the amount of delicate work in the analyses:—

"It is proper that I should state that great pains have been taken in the analyses to arrive at correct results. In the beginning great difficulty was experienced in obtaining chemicals of the requisite purity, and it was only after considerable time and trouble that acids absolutely pure were secured. In order to make certain that, if any of the metals tested for were found, they were

contained in the gold itself, blank analyses were made before each analysis of the gold, using the same apparatus and chemicals."

Thus far the only metals whose presence we have accounted for are iron and silver. The next question which arises is, How came the tin and mercury in the fillings in which they were found?

Almost every dentist now uses amalgam in greater or less quantity. This remains on the instruments in minute amounts, often invisible; and when, by accident or otherwise, the same burnishers perhaps are used in making a gold filling, a little of the amalgam gets upon the surface, showing itself after a time as a discolored filling. That this is a frequent cause of discoloration I have no doubt, and only by performing all amalgam operations in another room with an entirely separate set of instruments can we hope to get rid of the trouble As an illustration, I should like to mention the following case: An amalgam filling had been made in the morning, the hands carefully washed, and other fillings of gold made before lunch. In the afternoon a large gold filling had been almost completed, but needed a little burnishing. The gold burnisher was moistened with soap and applied to the filling, which directly changed color. An examination of the burnisher showed the same trouble. For a long time I was unable to account for the mischief. At last it was traced to the soap, to which a little of the amalgam must have clung when the hands were washed in the morning after using the amalgam.

In the beginning of the paper three ways were suggested in which impurities might get into gold fillings. I have shown that in the first and second of these ways impurities are introduced, and with regard to the third way the following may be said: Certain medicines, as iron, when allowed to remain in contact with the teeth, cause a discoloration of the debris which collects about the fillings and on their surfaces. In the mouths of those who smoke, the deposits of epithelial cells mixed with lime and germs which collect about imperfectly cleaned fillings become darkened. This discoloration makes fillings in some cases almost black. Discolored fillings are due to many different causes, as I have shown. In conclusion, the following suggestions, if faithfully carried out, will do away with some of these causes:—

Demand purer gold from the makers. Use this in the form of plain foil, because this is least liable to contamination.

Never touch gold foil with steel instruments of any kind. If it is necessary to heat the gold, do this on platinum.

Keep a separate set of instruments for amalgam. Insist upon a thorough cleaning of the mouth every time food or medicines are taken.—*Boston Med. and Surg. Journal.*

DENTAL SOCIETIES.

AMERICAN DENTAL ASSOCIATION.

TWENTY-FOURTH ANNUAL MEETING AT SARATOGA.

Reported for the ARCHIVES OF DENTISTRY by Prof. Chas. Mayr.

(Continued from page 422.)

WEDNESDAY, AUGUST 6, 1884.

MORNING SESSION.

The meeting was called to order at 10 o'clock A., M.; President Darby in the chair. The privileges of the floor were voted to Prof. Chas. Mayr, of Springfield, Mass., and to Drs. Bazin, Lovejoy, Borden and Andres, of Montreal.

The discussion of the paper by Dr. Harlan, upon Pyorrhœa Alveolaris, was declared in order.

Dr. Shepard.—Hoped that speakers would be exact in their expressions. He himself had said yesterday, "dilute sulphuric acid." That was inexact. He should have given the strength. He intended to have added, "in the proportion of one part of sulphuric acid to three of water."

Dr. Atkinson.— If the speaker meant one part of acid to three of water, that would be much stronger than the tincture of *aromatic* sulphuric acid.

Dr. Shepard.—I meant aromatic sulphuric acid.

Dr. Atkinson.—Then the gentleman was not exact when demanding that others should be.

Dr. Searle.—I like to ask the questions, why and what. In the first place, why do we use these various remedies? I think we have not gone deep enough into the nature of the disease. We hear it said sometimes that decalcification and caries are synonymous; also pyorrhœa and decalcification. They are both diseases of the soft tissues. The lime salts have nothing to do with them. If I have rightly studied pyorrhœa, I should declare it a disease of the pericementum. Originally it is set in action by some irritant, and that irritant may be tartar, lower organisms, or mechanical irritation

but whatever may be the cause, the disease starts in the pericementum, and works itself far down between the alveolus and the cementum before it makes itself manifest at all. The disease has been operating, usually, for a long time before we notice it, and, unless we can apply our remedies to the special part affected by the disease, we might just as well throw them on the sidewalk. We all know that ptyalism and the various affections of the mucous membrane are not pyorrhœa. We know that inflammation is not the disease in question until it progresses to a certain stage. Now, where does pyorrhœa commence? We cannot define exactly at what point of the inflammation of the peridental membrane the disease commences, but probably during the stage when the pericementum itself becomes involved in the disease. To cure the disease we have to remove all foreign matter; we must go down to the point of union between healthy and diseased tissue and treat it as a disease, not as an injury. How shall we treat it? After removal of foreign matter we dress it like any other wound, as nearly antiseptically as possible; whether it is a germ disease or not I do not know, but in some cases it may be, and deserves as much an antiseptic treatment as any similar disease. The best antiseptic dressing I am acquainted with is carbolic acid, full strength, applied, as stated last night, far down to the point of union between the diseased and healthy tissue. What more can you do? The teeth cannot rest; you cannot apply a plaster as to an ulcer of the skin; in ulcers around teeth the carbolic acid itself will form a coating by coagulation, which will keep out extraneous matter. How about repeating the treatment every few days? I would say let it alone, most severely. Having once performed an operation, amputated a limb and dressed it, let it get well alone; give nature a chance; do not disturb it. Somebody spoke of the application of external friction; this, I think, is perhaps the best way of removing food, foreign substances, etc, that lodge accidentally between the alveolus and the roots of the teeth. Let your patient place the finger low down and move it up so as to compress the tissues, and then rinse the mouth with a bucketful of water.

Dr. Stockton.—It does not seem necessary to say any more about the subject, as any one who kept his ears open last evening evidently knows everything about it. One gentleman, very prominent in the profession, said it was caused by deposits, and could be cured by remedies; another said it was not caused by deposits,

and could not be cured by remedies; one said a saturated solution of an acid would cure it; the other said there was no such thing as a saturated solution. I do not know any more about it than I did before coming. I thank Dr. Harlan for his paper, and hope he will give us the etiology of the disease another year.

Dr. Hunt.—Considers the disease constitutional, and thinks people and tribes, who live simply in accordance with the laws of nature have better teeth than the inhabitants of so-called civilized countries. He also considers the disease one of the symptoms of urinary troubles, not the cause.

Dr. Searle.—Cases at which I have been pegging away for five or eight years have yielded in a short time to strong carbolic acid.

Dr. Pierce.—I did not mean to say that urinary calculus was the cause of pyorrhœa, but the systemic condition which is cause for one disease is also for the other. There are cases of pus in the alveolar socket, due to local causes; these removed, the disease will subside. Pyorrhœa is hereditary in many cases; I think if inquiries are made among patients, you will hear them tell that "father and mother lost their teeth in the same way;" "all the teeth of father and mother came out without decay, all sound," etc. I do not believe in the transmission of disease, but of tendencies to it.

Dr. Watkins.—Dr. Pierce thinks the disease cannot be cured; I would like to relate a case where, I think, I cured it. It was one of the lateral incisors, elongated, pressed out of position, surrounded with pus pockets everywhere except in one small space on the labial surface; the tooth was very loose; I examined it and found a very little tartar about half way up the root; I removed this and the border of the alveolus, which was necrosed; I applied aromatic sulphuric acid, full strength. A week afterwards the patient came again, and I found that I had overlooked a small spot; I treated this in the same manner, and dismissed the patient; this was three years ago, and the tooth is now sound in its socket.

Dr. Howe.—Exhibited a few instruments; one a syringe with a fine platinum tube, the other a scaler to remove deposits by pushing or pulling, and the sides shaped so as to scrape the diseased alveolus.

Dr. Harlan.—The difference between salivary calculus and pyorrhœa are great. In the first affection the pericementum has not been detached beyond the line of deposit. In any event the salivary deposit is all around the necks of the teeth, and continuous,

not broken up into islands. The pericementum cannot be lifted from the root of the tooth beyond the line of salivary deposits. Whatever may be the initiative of pyorrhœa, if mechanical, chemical, traumatic, or anything else, it has a beginning at the gingival margin, on the ligament surrounding the neck of the tooth. It is believed, in connection with this injury, that micro-organisms of a peculiar form are found; that they manufacture a soluble ferment, which destroys the tissues in advance. If that theory be correct it is necessary that a remedy to destroy these micro-organisms should be injected. The reason for the frequent injection is, that the remedy you use may destroy the developing organisms, but not destroy the spores, so that in three or four days it would be necessary to repeat the injection and so on, until all spores have been destroyed. Dr. Black, of Jacksonville, has advocated this theory. It is no wonder that Dr. Pierce comes to the conclusion that the disease is not curable if he uses only one remedy which, as he himself says, cannot be applied in all cases. I have received hundreds of letters from all over the United States; I have visited the colleges, and their officers have told me they were trying the treatment I recommended. They have asked me to see the patients, and when I asked for the remedies and instruments to show how to manipulate the one and to use the others, they did not have them. How can a gentleman expect to accomplish anything unless he himself will faithfully try and be honest? It is no criticism against a method or treatment, if the criticizer himself does not practice or attempt to practice what is advocated.

Dr. Brown.—There seems to be two grounds taken in this discussion; the one that pyorrhœa can be cured, the other that it cannot. Now, let us take an intermediate ground. Who would think to condemn a physician because, when he cured a sore throat, it recurs in a year, nor, if any one had cured pyorrhœa alveolaris, and the disease reappeared in three or four years; the dentist takes generations of treatment to cure disease and eradicate it? The child says, "mother's teeth dropped out and sister's did; I come to you fearing the disease." The question is not whether it can be cured permanently. Dr. Harlan is right; he has cured cases; so have I, and so have we all; but can one tell what the cases will be five years hence? Many will recur. Does a man allow his wooden house to burn down because it caught fire three or four times, while his neighbor's stone house even burned?

Dr. Shepard.—From my observations I think the disease can be wiped out in the first generation. Taken in the incipient stages it is as curable as any disease; there will be no loss of the alveolar processes. Patients should bring their children to us in early life; the tendencies, as Dr. Pierce said, are hereditary. We need to watch them. The term pyorrhœa, meaning originally pus-flow, is used to mean the loss of tissue and the ensuing inflammation. The section of nomenclature has not been active in the proper direction.

Dr. Atkinson.—We have heard a great deal of good sense and of nonsense; some have classified diseases in the plural before they have defined them in the singular, and they have got so tangled in perception that we have had a hodge-podge of brilliant perceptions so intermingled as to be made worthless. Let us get our minds to the point of what a disease is, and how it acts, and whether it is capable of being limited or annihilated. There is such a thing as antidoting diseased activity which is the result of the introduction of foreign elements into the functioning body. Every phlegmonous abscess is self-limiting and self-curing. It will go in the direction of least resistance. If the flow of pabulum by pressure is prevented, it will abort. Why does not pyorrhœa alveolaris heal? It is the introduction of micro-organisms which float in the air that set up a ferment adverse to the formation of tissues, so that they can be built after the type of the tissue. I cured a case of twenty-four years standing in eight days. I then used wood creasote. What is recurrence? It is either repetition or imbecility on the part of the investigator, or malevolence by persisting in a wrong position. These cases of which we speak as recurrences are simply territories only inclosed a little, but not healed, in which the bacteria had sufficient oxygen to keep them alive, and they broke down the tissue, until it made its way by the recuperative law and broke through on to the surface or took another way of curing, which is encystment, whereby the foreign body becomes a mineral in its function, like a bullet in the body, remaining encysted for years. I have in my own person a splinter of wood that has become resorbed so much that I find it only occasionally. When you have removed the body inimical to the organization, that organization alone does the cure. Anything may be according to organization, a food, a poison, or a remedy. On motion the subject was passed.

[TO BE CONTINUED.]

BIBLIOGRAPHIC.

THE FORMATION OF POISONS BY MICRO-ORGANISMS. By G. V. Black, M. D., D. D. S. Philadelphia: P. Blakiston, Son & Co. 1884.

This work is devoted to an argument in favor of the germ theory of disease. It is arranged in the form of lectures, seven in number to which is added an appendix.

The first lecture comprises a brief history of the subject under consideration, and the discussion of the views of the earlier writers upon it.

The second lecture opens with a review of the theory put forth by Dr. Bastian relative to the de novo origin of life. This theory is remotely related to the germ theory of disease, but is sufficiently so to entitle it to notice, and for that reason it is considered in this work.

Dr. Bastian holds that the molecular movement theory, by being continued under favorable conditions, actually produces the living forms found in the culture fluids of Pasteur and other recent experimentalists. (This view is pretty generally disputed by other scientists, and, although a very large majority deny the correctness of Dr. Bastian's views the question still remains undetermined.—EDITOR.) The main subject is again resumed and the views of Schw ann, Latour, Pasteur, Lister, Billroth, Klebs, Virchow and others explained. In the third lecture the peculiar views of Dr. Beale are considered, followed by those of Koch and others, all of which leads our author to the conclusion that "All the foregoing taken together, gives strong presumptive evidence that all contagious and infectious diseases are produced by disease germs."

The fourth lecture considers "The Relation of Micro-Organisms to the Production of Disease." In the treatment of this branch of the subject the following propositions are presented "as a basis for a further study of the subject."

First, Experiment has shown there are many micro-organisms which do not produce disease; and that there are certain other micro-organisms that do induce disease when introduced into the bodies of men or animals.

Second, That poisons have originated in connection with these disease-producing organisms.

Third, That these poisons seem to be a product of the organisms and may be separated from them; and when so separated produce direct poisoning.

Fourth, "This poisoning is different from the disease induced by the organisms in that it is direct, and comparatively immediate, while infectious disease arises only after a more or less definite stage of incubation." And

Fifth, That probably "infectious disease is caused by a micro-organism that is capable of developing in the tissues, or blood, and forming poisons through changes wrought in the molecular forms of matter, by virtue of its vital energies; or, the physiological processes of digestion, nutrition and the formation of waste products."

Having shown the fact that micro-organisms are regularly connected with certain processes of disease and that these processes do not occur without their presence, this branch of the subject is disposed of as follows: "The Germ Theory of Disease, as it stands to-day, is essentially a mass of unexplained facts, developed by direct experiments of the most subtle nature; so subtle, indeed, that there are but few men who have the natural endowments necessary to verify them.

Then follows a brief discussion of the subject of digestion, including absorption, nutrition and the formation of waste products.

The action of ferments is carried forward to the assimilation of nutrition by the tissues themselves.

In the fifth lecture the same subject is continued under the heads of Resorptive Digestion, Digestion of Blood-clot, Digestion of ligatures, of sponge, etc.

In the Sixth lecture, Waste Products are considered with reference to the germ theory of disease, and in the Seventh, Poisons and the manner in which low organisms produce disease.

The Appendix is devoted to the consideration of Dental Caries and Its Relation to the Germ Theory of Disease.

Our space forbids little more than a simple enumeration of the chief topics treated of in this notable volume. That it offers much food for thought is but a tame expression of the value of its contents. The book is a continuous argument and must be read by all who desire to gain an intelligent perception of the views put forth, and of the testimony adduced in their support.

EDITORIAL.

The translation of the article from *Le Progres Dentaire*, Part I. of which is presented in this issue of the ARCHIVES on "The Histogeny and Histology of the Dental Organ" is by Professor Chandler, of Boston, whose previous work in this direction has hardly received the recognition from the profession which its merit demands. The addition of his name to the corps under whose management the ARCHIVES will be conducted,under the new regimé, is a guarantee to our readers that they will from time to time be presented with translations from the French and German of whatever is most valuable in our contemporary professional literature. The author of the paper under consideration makes, as will be seen, little claim for originality, As a resumé of all that is known upon this subject in England, and upon the Continent, its appearance here is at a very opportune time. Our readers will be able to compare it with the recent contributions to the literature of this subject by our American writers. The absence of illustration, so essential in work of this kind, makes necessary some familiarity with the subject in order to fully appreciate the value of the paper. As a mass presentation, it could hardly be expected that the author would enter into minute details at any very considerable length, but the salient features are, nevertheless, very clearly brought out.

There are several points in the paper not altogether in harmony with what we believe has recently been very clearly demonstrated by our American writers upon this subject. The author speaks of the teeth in the opening of his paper as developed progressively from minute papillæ situated in a groove lined with mucous membrane. It has been shown that the teeth are developed in a closed sac situated *beneath* the mucous membrane and, after the breaking up of the epithelial cord, the *gubernaculum dentis* of the author, which occurs in the early stages of development. According to the most recent observations, this sac, inclosing the developing tooth-germ, has no direct connection with the mucous membrane, until just previous to the eruption of the tooth, or about the time of the completion of the formation of the cementum, when the pericementum becomes united to, or continuous with the gum tissue surrounding the tooth. The author does not seem to have very clear ideas of the process of absorption of the roots of the temporary teeth. Upon this point we think the recent contributions of Professor Abbott and Dr. Williams much clearer and more satisfactory. There are other points, of which mention may be made, as the origin of the *persistent capsule* of Nasmyth, and the termination of the nerve fibers of the pulp, which are open to criticism, but, on the whole, the paper is well worth careful perusal. The latter points are contained in Part II of the article which will appear in the December number.